MEMORANDUM

Date: 06 June 2016

To: Jennifer LaPoma (EPA R2), Chuck Nace (EPA R2), Beth Franklin (USACE-KC),
            Scott Kirchner (CDM),
From: Norm Richardson (Battelle), Betsy Barrows (Battelle)

Subject: Evaluation of CPG Issues Related to Application of EPA Region 2's Sediment
            Quality Triad Guidance for the LPR 17-Mile Baseline Ecological Risk
            Assessment

The purpose of this technical memorandum is to evaluate two issues recently raised by the CPG in a 7 April 2016 memo from Rob Law to Jennifer LaPoma. These issues regard the application of EPA R2's Sediment Quality Triad (SQT) methodology to the selection of individual reference stations for use in the 17-Mile Baseline Ecological Risk Assessment for the Lower Passaic River (LPR):

1. Chemical and toxicity screening of reference stations above Dundee Dam; the CPG reported finding several inconsistencies between their screening calculations and those previously provided to them by USEPA.

2. The availability of sufficient data to define reference conditions (i.e., reference envelope) for freshwater portions of the Mullica River and brackish/estuarine habitat in the Mullica River and Great Bay in Atlantic County.

The specific focus of this analysis was to independently identify individual reference stations that pass the combined chemical and toxicity screening criteria established in the EPA R2 methodology and compare the list of acceptable reference stations to the CPG's findings. In addition, research was conducted to identify relevant SQT data for the Mullica River/Great Bay reference area and to screen these data for acceptability. Remaining areas of inconsistency between the Battelle and CPG calculations area identified and specific uncertainties discussed.

1   Methodology

Battelle calculated screening criteria based on a database summary provided by Scott Kirchner (CDM) and identified sampling stations in the above Dundee Dam reference area that would be acceptable[1] in accordance with the EPA R2 SQT methodology. Implementation of the standard SQT procedure requires that acceptable data for sediment chemistry, laboratory toxicity, and benthic community structure all be available for each station included in the analysis and accordingly, sampling stations that lack one or more components were not included in this evaluation[2]. The project database does not include data for the Mullica River/Great Bay

---

[1] A station is considered to pass the chemical screening step specified in the R2 SQT methodology when the overall screening criterion is less than 0.50 and only this subset of reference stations can be used in defining the reference condition for comparison to study area stations.

[2] Information provided in the file "20160407 BERA Reference SQT Samples screen to R2.xlsx" was used to identify the subset of stations in the Above Dundee Dam Reference Area that could potentially be used in a SQT analysis. According to the CPG's assessment, requisite information is available for 24 of the 40 sampling locations above Dundee Dam.

reference area; however, there is a fairly large set of environmental data available that is relevant to SQT analysis, including that derived from the National Coastal Assessment program between 2000 and 2006 and a follow-up study in 2010. Battelle downloaded information from the NOAA QueryMaster and USEPA STORET databases and received data files from various NJDEP staff.

The "Data Usability and Data Evaluation Plan for the Lower Passaic River Study Area Risk Assessments – Final" document (Windward, 2014) specifies data decision rules for preparing data for use in calculating chemical exposures in risk assessments. The document identifies various data reduction rules that were adhered to including those concerning calculation of total concentration estimates, selection of analytical parameters, selection of single values among multiple analytical results, and treatment of non-detects. Specifically, the following data reduction rules were followed in the calculation of mPECq values:

- Total Concentration Summation Rules. Rule 1 (for non-toxicity-weighted totals; relevant to PAH, PCB and pesticide chemical classes) – totals were based on the sum of detected constituent parameters with zero used for non-detected parameters. In cases where none of the constituent parameters were detected, the total concentration was based on the highest reporting limit for the constituent parameters. Partial totals were calculated in cases where analytical results for one or more of the constituent parameters were not reported.
- Constituent Parameters. Table 4-1 identifies the individual chemical parameters that should be included in the derivation of total concentration sums for PAHs, PCBs and pesticides (total chlordanes, total endosulfan, and total DDx). For other pesticides, only individual results were compared to available PEC values.
- Samples with Multiple Results. Multiple results are available for PAH compounds because samples were analyzed using both SVOC (SW827D) and high-resolution SIMS (CARB429 MOD) methods. Results for the high-resolution method were used preferentially[3] in the calculation process.
- Field duplicates. Field duplicate analytical results are available for two sampling locations above Dundee Dam (i.e., UPR18A and UPR18J); however, only the latter meets the data requirements for conducting a SQT. The evaluation plan document specifies several rules[4] for treating duplicate results. Analytical results for the field duplicate result for UPR18J are ignored in the preliminary results presented herein.

Chemical screening was conducted using Probable Effect Concentration (PECs) and Effect Range – Low and Effect Range – Median (ER-Ls/ER-Ms) values for freshwater and estuarine habitats, respectively. PEC quotients (PECq) were calculated as the ratio of a chemical concentration of a given analytical parameter divided by a corresponding freshwater threshold concentration, as presented in MacDonald et al., 2000[5]. PECqs are available for eight individual metals, total PAHs, total PCBs, and pesticides (including total chlordanes, dieldrin, endrin, gamma-BHC, heptachlor epoxide and total DDx). Chemical-class specific mean PECq (mPECq) values were calculated for each sampling station as the average PECq values for all analytical

---

[3] High-resolution results were not available for benzo(b)fluoranthene so results for the SW827D results were used for this parameter in the calculation of total PAH estimates.

[4] That is, average of detected values, detected value when the parameter is only detected in one of the two samples, and average of the two RLs when the constituent is not detected in either sample.

[5] MacDonald, D.D., C.G. Ingersoll and T.A. Berger, 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosytems; *Arch. Environ. Contam. Toxicol.* 39:20-31.

parameters within that chemical class and an overall mPECq for each station was estimated as the average of the four chemical class-specific values. As stipulated in the R2 SQT methodology, a station is considered to pass the chemical screen if the mPECq is less than 0.5.

ER-L/ER-M values are available for nine metals, 13 PAHs as well as Total PAHs, Total PCBs, Total DDx and 4,4'-DDE. Available analytical data for these analytes were compared to both ER-L and ER-M values and an estuarine station is considered to pass the chemical screen only if no ER-M is exceeded and there are no more than 3 exceedances of ER-Ls.

The final component of the screening process was to compare available control-adjusted mortality data to threshold values stipulated in the R2 SQT methodology:

- freshwater stations - control-adjusted mortality for all species tested must equal or exceed 75%; and,
- estuarine stations - control-adjusted amphipod mortality tested must equal or exceed 80%.[6]

2. Results

Table 1 summarizes the chemical-class mPECq values calculated following the procedures described in Section 1 and compares the overall mPECq values with those provided by the CPG. The Battelle and CPG calculations are consistent and no differences in acceptability classification were identified.

The EPA R2 guidance indicates that both the available SQT data for locations in freshwater Mullica River and brackish/estuarine Mullica River/Great Bay habitat should be included in the SQT analysis. The CPG reported that their screening evaluation determined that only two Mullica River/Great Bay locations have the requisite set of SQT information and that only one of these passes the chemical screening described in the EPA R2 SQT guidance. Based on Battelle's screening evaluation, fourteen[7] acceptable reference stations were identified in the Mullica River/Great Bay dataset (Table 2). Table 3 presents the results of the screening process assuming that four Mullica River stations actually represent freshwater habitat. The combined chemical (using PECs rather than ER-L/ER-M values) and toxicological screening evaluation identified three acceptable reference stations.

---

[6] Several Mullica River stations may represent freshwater habitat based on salinity data and preponderance of freshwater taxa in the benthic grab samples. Toxicity test results for these stations are based on amphipod exposure.
[7] One station NJ0x-0038 was sampled twice and passed the screening process both times.

Table 1. Summary of Screening Evaluation – Above Dundee Dam

Location	Full SQT?	Chemical Class-Specific PECq				mPECq		Pass Sediment Chemistry Screen?[a]	C. dilutus survival (% of control)	H. azteca survival (% of control)	Pass Sediment Toxicity Screen?[b]	Acceptable for Use in BERA?
		Metals	PAHs	PCBs	Pesticides	Battelle	CPG					
UPRT18H	Yes	0.24	0.46	0.08	0.12	0.23	0.23	Yes	0.959	0.944	Yes	Yes
UPRT18I	Yes	1.32	2.35	0.13	0.15	0.99	1.0	No	0.724	0.811	No	No
UPRT18J	Yes	0.35	1.38	0.28	0.20	0.55	0.65	No	0.908	1.000	Yes	No
UPRT18K	Yes	0.19	1.57	0.11	0.13	0.50	0.51	No	0.878	0.833	Yes	No
UPRT19J	Yes	3.62	67.80	0.02	0.02	18	18	No	0.039	0.000	No	No
UPRT19K	Yes	0.19	2.28	0.14	0.19	0.70	0.68	No	0.755	0.989	Yes	No
UPRT19L	Yes	0.20	0.45	0.05	0.07	0.19	0.20	Yes	0.796	0.722	No	No
UPRT19M	Yes	0.17	0.26	0.06	0.05	0.14	0.14	Yes	0.816	0.489	No	No
UPRT20A	Yes	0.22	0.69	0.05	0.14	0.28	0.28	Yes	0.806	0.667	No	No
UPRT20B	Yes	0.23	0.41	0.04	0.16	0.21	0.21	Yes	0.816	0.833	Yes	Yes
UPRT20C	Yes	1.93	4.42	0.40	0.54	1.8	1.9	No	0.918	0.844	Yes	No
UPRT20D	Yes	1.09	5.00	0.49	0.15	1.7	1.7	No	0.806	0.822	Yes	No
UPRT20E	Yes	0.13	0.55	0.02	0.08	0.19	0.20	Yes	0.867	0.733	No	No
UPRT20F	Yes	1.71	29.76	0.03	0.08	7.9	8.0	No	0.551	0.014	No	No
UPRT20G	Yes	0.21	0.19	0.05	0.10	0.14	0.13	Yes	0.867	0.756	Yes	Yes
UPRT21A	Yes	0.15	0.56	0.01	0.06	0.20	0.19	Yes	0.908	0.767	Yes	Yes
UPRT21B	Yes	0.58	1.03	0.35	1.54	0.88	0.86	No	0.806	0.211	No	No
UPRT21C	Yes	0.28	0.78	0.05	0.10	0.30	0.32	Yes	0.745	0.867	No	No
UPRT21D	Yes	0.16	0.13	0.01	0.05	0.087	0.08	Yes	0.724	0.700	No	No
UPRT21E	Yes	0.20	1.52	0.06	0.09	0.47	0.39	Yes	0.857	0.644	No	No
UPRT21F	Yes	0.21	0.63	0.13	0.68	0.41	0.41	Yes	0.898	0.811	Yes	Yes
UPRT21G	Yes	0.62	0.47	0.03	0.07	0.30	0.30	Yes	0.847	0.700	No	No
UPRT22A	Yes	0.12	0.06	0.17	0.05	0.097	0.10	Yes	0.714	0.889	No	No
UPRT22B	Yes	0.15	0.99	0.02	0.06	0.31	0.21	Yes	0.827	0.656	No	No

Notes:
Pink shading indicates a screening fail condition.
a. mPECq value must be less than 0.5 to pass the chemical screen.
b. Both control-adjusted percent survival values must ≥ 75% to pass the toxicity screen.

Table 2. Summary of Screening Evaluation – Great Bay/Mullica River (Estuarine Habitat)

Location[a]	Complete SQT Dataset?	No. of Parameters Exceeding ERL	No. of Parameters Exceeding ERM	Pass Sediment Chemistry Screen?[b]	A. abdita survival (% of control)	Pass Sediment Toxicity Screen?[c]	Acceptable for Use in BERA?
NJ00-0035	Yes	4	0	No	98.9	Yes	No
NJ00-0041	Yes	0	0	Yes	85.1	Yes	Yes
NJ01-0036	Yes	0	0	Yes	98.9	Yes	Yes
NJ01-0038	Yes	3	0	Yes	101	Yes	Yes
NJ01-0116	Yes	4	0	No	92.2	Yes	No
NJ01-0118	Yes	3	0	Yes	84.4	Yes	Yes
NJ01-0120	Yes	10	3	No	89.5	Yes	No
NJ01-0122	Yes	1	0	Yes	97.9	Yes	Yes
NJ02-0227	Yes	1	0	Yes	100	Yes	Yes
NJ02-0229	Yes	4	0	No	91.5	Yes	No
NJ02-0230	Yes	0	0	Yes	107	Yes	Yes
NJ02-0232	Yes	0	0	Yes	87.2	Yes	Yes
NJ03-0038	Yes	0	0	Yes	88	Yes	Yes
NJ04-0427	Yes	5	0	No	90.1	Yes	No
NJ04-0429	Yes	3	0	Yes	95.7	Yes	Yes
NJ04-0432	Yes	0	0	Yes	79.6	No	No
NJ05-0059	Yes	3	0	Yes	92.9	Yes	Yes
NJ06-0015	Yes	2	0	Yes	100	Yes	Yes
NJ06-0027	Yes	2	0	Yes	94.8	Yes	Yes
NJ06-0035	Yes	0	0	Yes	100	Yes	Yes
NJ06-0046	Yes	0	0	Yes	41.8	No	No
NCCA10-2622	Yes	0	0	Yes	85	Yes	Yes

Notes:
a. Identified freshwater stations in red font; failing screening results identified in red shading - overall mPECq value must be less than 0.5 to pass the chemical screen.
b. No ER-M exceedances and less than 4 ER-L exceedances required to pass the chemical screen.
c. *A. abdita* survival ≥ 80% of negative control result required to pass the toxicity screen.

Table 3. Summary of Screening Evaluation – Great Bay/Mullica River (IdentifiedFreshwater Habitat)

Location[a]	Complete SQT Dataset?	Chemical Class-Specific PECq				mPECq	Pass Sediment Chemistry Screen?[b]	A. abdita survival (% of control)	Pass Sediment Toxicity Screen?[c]	Acceptable for Use in BERA?
		Metals	PAHs	PCBs	Pesticides					
NJ00-0041	Yes	0.055	0.022	0.003	0.002	0.020	Yes	85.1	Yes	Yes
NJ01-0120	Yes	0.057	0.734	0.000	0.000	0.20	Yes	89.5	Yes	Yes
NJ02-0232	Yes	0.071	0.006	0.000	0.000	0.019	Yes	87.2	Yes	Yes
NJ06-0046	Yes	0.063	0.050	0.000	0.000	0.028	Yes	41.8	No	No

Notes:
a. Failing screening results identified in red shading.
b. mPECq < 0.50 required to pass the chemical screen.
c. *A. abdita* survival ≥ 80% of negative control result required to pass the toxicity screen.

3. Conclusions

Table 4 summarizes the list of acceptable reference stations determined in this review. The list of Above Dundee Dam reference stations is consistent with the results of the CPG's evaluation. For the Mullica River/Great Bay reference dataset, the CPG's evaluation concluded that complete

SQT datasets were only available for two stations (i.e., NJ03-0038 and NJ04-0429) and that only one passed the combined chemical and biological screening process. With regard to NJ04-0429, which Battelle concludes does pass, the inconsistency between the Battelle and CPG conclusions relates to the number of ER-L exceedances (3 versus 4, respectively). The CPG scored cadmium as an exceedance although the reported cadmium concentration (1.2 ug/g) is equal to the ER-L value and consequently does not represent an ER-L exceedance.

As it appears that different understandings on what SQT data are available for the Mullica River/Great Bay reference area accounts for most of the discrepancies in the Battelle and CPG screening evaluations, it is recommended that the CPG be provided with the information used in the Battelle evaluation. Based on the comparability of the chemical screens, it is expected that a consensus will be reached that a robust set of estuarine reference stations are available for this area. It is also recommended that the CPG review the existing water quality parameter and benthic taxonomic data for the three Mullica River stations that may represent freshwater habitat and a determination of their suitability for estimating freshwater reference condition be made.

Table 4. Acceptable Reference Stations

Reference Area	Station	Latitude	Longitude
Lower Passaic River - Freshwater Habitat			
Above Dundee Dam	UPRT18H	40.88622	-74.1291
Above Dundee Dam	UPRT21A	40.91759	-74.1306
Above Dundee Dam	UPRT20G	40.91552	-74.1324
Above Dundee Dam	UPRT21F	40.92333	-74.1357
Above Dundee Dam	UPRT20B	40.90481	-74.1322
Mullica River/Great Bay - Estuarine Reference Habitat			
Great Bay	NJ01-0036	39.5110	-74.2970
Mullica River	NJ01-0038	39.5568	-74.4796
Mullica River	NJ03-0038	39.5568	-74.4796
Mullica River	NJ01-0118	39.5525	-74.4544
Mullica River	NJ01-0122	39.5850	-74.5383
Great Bay	NJ02-0227	39.4980	-74.3330
Great Bay	NJ02-0230	39.5370	-74.3340
Mullica River	NJ04-0429	39.5680	-74.5020
Great Bay	NJ05-0059	39.5050	-74.3540
Great Bay	NJ06-0015	39.5360	-74.3880
Great Bay	NJ06-0027	39.5000	-74.4010
Great Bay	NJ06-0035	39.4960	-74.3600
Great Bay	NCCA10-2622	39.5079	-74.3357
Mullica River - Identified Freshwater Reference Habitat			
Mullica River	NJ00-0041	39.6120	-74.5890
Mullica River	NJ01-0120	39.6198	-74.6298
Mullica River	NJ02-0232	39.6290	-74.6420

4. Remaining Issues for Resolution

As mentioned in Section 3, it appears that differences in understanding of available relevant data for the Mullica River/Great Bay account for nearly all of the inconsistencies between the

conclusions drawn from the Battelle and CPG screening assessments. The following provides a discussion of several issues that may require further discussion with the CPG.

4.1. <u>Reference Data for Pristine Freshwater Habitat</u>. The CPG reviewed available SQT for 12 stations that appear to be part of the NJDEP Bureau of Freshwater and Biological Monitoring Ambient Biomonitoring Network (AMNET) study and based on a determination that only benthic macroinvertebrate community data were available for these stations, concluded that a freshwater reference conditions could not be developed for the Mullica River. However, 4 stations located in mid-reaches of the Mullica River appear to be freshwater habitat. Water quality data available from the National Coastal Assessment (NCA) monitoring program (see https://archive.epa.gov/emap/archive-emap/web/html/index-124.html) suggest that conditions at the time of data collection are best characterized as freshwater for 3 stations (salinity ranging from 0 to 0.43 ppt) and just slightly brackish in the fourth station (NJ06-0046, salinity 1.6 ppt). In addition, the benthic community associated with these stations is predominately freshwater in terms of salinity tolerance. Table 5 summarizes the numerically dominant taxa (including all taxa representing at least 9% of the individual organisms sampled). The listed taxa represent between 61-81 percent of the total benthic samples and all are considered representative of freshwater conditions.
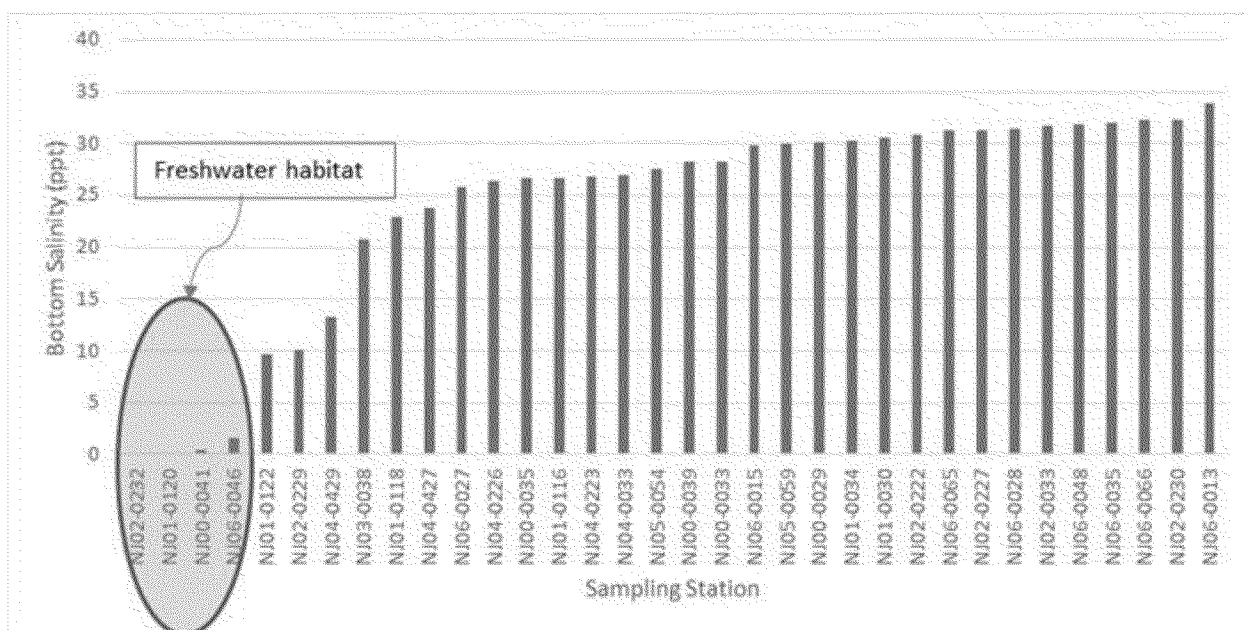

Figure 1. Ranked Bottom Water Column Salinity Measurements - Mullica River/Great Bay NCA Sampling Stations

Table 5. Relative Abundance of Numerically Dominant Taxa

Taxon	Sampling Station			
	NJ00-0041	NJ01-0120	NJ02-0232	NJ06-0046
Apocorophium lacustre	16%			
Chiridotea arenicola				17%
Chironomidae			40%	
Dicrotendipes		22%		
Ephemeridae			20%	
Gammarus palustris	31%			16%
Stictochironomus	27%			11%
Tubificidae		49%		17%
Unionicola		10%	9%	
Combined Relative Abundance	74%	81%	69%	61%

4.2 <u>Concurrent SQT Component Sample Collection</u>. Initial feedback received from the CPG regarding the lack of consensus about data availability for Mullica River/Great Bay sample stations (the Battelle review identified 15 (including 3 freshwater stations) distinct sampling stations with a full complement of SQT data that pass the combined chemical and biological screening compared to the single station identified by the CPG) suggested that the SQT components may not have been collected concurrently[8]. Although sample collection dates for the SQT components from the 2000 – 2006 NCA program have not been located, the archived EPA website (https://archive.epa.gov/emap/archive-emap/web/html/index-124.html) does include a file containing sampling event data. These data indicate that each station was visited once during the sampling year corresponding to the sample identifier (e.g., NJxx-yyy, where xx refers to year and yyy refers to a unique location). It is reasonable to assume that the necessary sample material (sediment for laboratory toxicity and chemical analysis and benthos for community metric calculations) were collected on the date indicated. This similarly applies to the REMAP datasets for Jamaica Bay.

4.3 <u>Planning Documentation for NCA Sampling Program</u>. As with the Jamaica Bay dataset, SQT information for Mullica River/Great Bay was not collected specifically to support the LPR RI/FS program and the CPG has expressed concerns in the past about use of and reliance on secondary data sources unless adherence to a number of strict criteria can be demonstrated. Specific QAPP and other planning documentation is not available on the archived EPA NCA-NJ website although this information is likely available. The probabilistic sampling design approach utilized in the NCA-NJ program followed EMAP protocols (also used in the Jamaica Bay reference datasets) and field sampling protocols are described in EPA, 2000[9]. EPA conducted high level QC checks prior to

---

[8] If this were the case, one could argue that the chemical, benthic community and laboratory toxicity "triad legs" might not be multiple lines of evidence for the same set of environmental exposures.
[9] USEPA, 2000. Coastal 2000 Northeast Component Field Operations Manual; EPA/620/R-00/002, Office of Research and Development, April. 86pp.

uploading the data; however, the individual state partner agencies (i.e., New Jersey) were assigned primary responsibility for overall data quality assurance during implementation of the NCA program. In addition, individual states were allowed to modify EMAP protocols for concordance with ongoing monitoring program as long as consistency with EMAP/NCA objectives could be demonstrated. If necessary, specific details may be available by contacting appropriate NJDEP personnel.

4.4   Chemical Screening and Significant Figures. This issue is associated with one of the few disagreements between the CPG and Battelle chemical/toxicity screening evaluation[10]. The EPA R2 SQT methodology includes an ER-L exceedance count threshold (i.e., no more than 3/station). The difference in reference acceptability determination for NJ04-0429 is due either to a classification error (i.e., analyte concentrations that equal their respective ER-L values should not be counted as an ER-L "exceedance") or attributed to differences in the number of significant figures provided in downloaded data. NCA-NJ data can be obtained from a number of sources including the archived EPA website, from a NOAA database and from NJDEP[11]. As the principal agency responsible for the National Coastal Assessment program, Battelle considered that EPA is the primary "owner" of these data and information provided in the archived NCA-NJ website should have primacy over alternative sources.

---

[10] As discussed in Section 3, Battelle concluded that station NJ04-0429 in the Mullica River passes the chemical screening with only 3 ER-L exceedances, whereas the CPG identified 4 ER-L exceedances and concluded that this station did not meet acceptability criteria.
[11] NJDEP provided a NCA dataset file that will be provided to the CPG.